3.3 INSTRUMENTATION

3.3.4 Control Rod Drive (CRD) Trip Devices

LCO 3.3.4

a. Four AC CRD trip breakers shall be OPERABLE for Unit(s) with the CRD/Reactor Trip Breaker (RTB) Upgrade complete.

b. The following CRD trip devices shall be OPERABLE for Unit(s) with the CRD/RTB Upgrade not complete:

1. Two AC CRD trip breakers;
2. Two DC CRD trip breaker pairs; and
3. Eight electronic trip assembly (ETA) relays

APPLICABILITY: MODES 1 and 2,
MODES 3, 4, and 5 when any CRD trip breaker is in the closed position and the CRD System is capable of rod withdrawal.

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each CRD trip device.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One or more CRD trip breakers diverse trip Functions inoperable OR One or more required DC CRD breaker pair diverse trip Functions inoperable.	A.1 OR A.2	Trip the CRD trip breaker. Remove power from the CRD trip breaker.	48 hours 48 hours

(continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. One or more CRD trip breakers inoperable for reasons other than Condition A. <u>OR</u> One or more required DC CRD breaker pairs inoperable for reasons other than Condition A.	B.1	Trip the CRD trip breaker.	1 hour
	<u>OR</u>		
	B.2	Remove power from the CRD trip breaker.	1 hour
C. One or more required ETA relays inoperable.	C.1	Transfer affected CONTROL ROD group to power supply with OPERABLE ETA relays.	1 hour
	<u>OR</u>		
	C.2	Trip corresponding AC CRD trip breaker(s).	1 hour

(continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action and associated Completion Time not met in MODE 1, 2, or 3.	D.1 Be in MODE 3. AND D.2.1 Open all CRD trip breakers. OR D.2.2 Remove power from all CRD trip breakers.	12 hours 12 hours 12 hours
E. Required Action and associated Completion Time not met in MODE 4 or 5.	E.1 Open all CRD trip breakers. OR E.2 Remove power from all CRD trip breakers.	6 hours 6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.4.1	Perform CHANNEL FUNCTIONAL TEST.	31 days

B 3.3 INSTRUMENTATION

B 3.3.4 Control Rod Drive (CRD) Trip Devices

BASES

BACKGROUND

The Reactor Protective System (RPS) contains multiple CRD trip devices: four AC trip breakers for Unit(s) with CRD/Reactor Trip Breaker (RTB) upgrade complete or two AC trip breakers, two DC trip breaker pairs and eight electronic trip assembly (ETA) relays for Unit(s) with the CRD/RTB upgrade not complete. For Unit(s) with the CRD/RTB upgrade not complete, the system has two separate paths (or channels), with each path having one AC breaker in series with a pair of DC breakers and functionally in series with four ETA relays in parallel. For Unit(s) with the CRD/RTB upgrade complete, the system has two separate paths (or channels), with each path having two AC breakers in series. In either case, each path provides independent power to the CRDs. Also, in either case, either path can provide sufficient power to operate the entire CRD System.

For Unit(s) with the CRD/RTB upgrade complete, Figure 7.1, UFSAR, Chapter 7 (Ref. 1), illustrates the configuration of Reactor Protection System (RPS) Reactor Trip Modules (RTM's) and the trip breakers. For Unit(s) with the CRD/RTB upgrade not complete, Figure 7.1a, UFSAR, Chapter 7 (Ref. 1), illustrates the configuration of the CRD trip devices. To trip the reactor, power to the CRDs must be removed. Loss of power causes the CRD mechanisms to release the CONTROL RODS, which then fall by gravity into the core.

Power to CRDs is supplied from two separate sources through the AC trip circuit breakers. For Unit(s) with the CRD/RTB upgrade complete, these breakers are designated A, B, C, and D and their undervoltage (trip) coils are powered by RPS channels A, B, C, and D, respectively. For Unit(s) with the CRD/RTB upgrade not complete, these breakers are designated A and B, and their undervoltage trip coils are powered by RPS channels A and B, respectively. From the circuit breakers, the CRD power travels through voltage regulators and stepdown transformers. For Unit(s)

BASES

BACKGROUND (continued)

with the CRD/RTB upgrade complete, these devices in turn supply redundant buses that feed the Single Rod Power Supply (SRPS). For Unit(s) with the CRD/RTB upgrade not complete, these devices in turn supply redundant buses that feed the DC power supplies and the regulating rod, APSR and auxiliary power supplies.

For Unit(s) with the CRD/RTB upgrade not complete, the DC power supplies rectify the AC input and supply power to hold the safety rods in their fully withdrawn position. One of the redundant power sources supplies phase A; the other, phase CC. Either phase being energized is sufficient to hold the rod. Two breakers are located on the output of each power supply. Each breaker controls half of the power to two of the four safety rod groups. The undervoltage trip coils on the two circuit breakers on the output of one of the power supplies is controlled by RPS channel C. The other two breakers are controlled by RPS channel D.

For Unit(s) with the CRD/RTB upgrade not complete, in addition to the DC power supplies, the redundant buses also supply power to the regulating rod, APSR and auxiliary power supplies. These power supplies contain silicon controlled rectifiers (SCRs) that are gated on and off to provide power to, and remove power from, the phases of the CRD mechanisms. The gating control signal for these SCRs is supplied through the closed contacts of the ETA relays. These contacts are referred to as E and F contactors, and are controlled by the C and D RPS channels respectively.

The following applies to Unit(s) with the CRD/RTB upgrade not complete:

The AC breaker and DC breakers are in series in one of the power supplies; whereas, the redundant AC breaker and DC breakers are in series in the other power supply to the CONTROL RODS. The logic required to cause a reactor trip is the opening of a circuit breaker in each of the redundant power supplies. (The pair of DC circuit breakers on the output of the power supply are treated as one breaker.) This is known as a one-out-of-two taken twice logic. The following examples illustrate the operation of the reactor trip circuit breakers.

a. If the A AC circuit breaker opens:

   1. the input power to associated DC power supply is lost, and

   2. the SCR supply from the associated power source is lost.

BASES

BACKGROUND (continued)

b. If the D DC circuit breaker(s) and F contactors open:

1. the output of the DC power supply is lost, and

2. when the F contactor opens, SCR gating power is lost.

c. The combination of (a) and (b) causes a reactor trip.

The following applies to Unit(s) with the CRD/RTB upgrade complete:

Two AC breakers (A and C) are in series to feed one redundant train of the SRPS, whereas the other two series AC breakers (B and D) feed the other redundant train of the SRPS. The minimum required logic required to cause a reactor trip is the opening of a circuit breaker in each parallel path to the SRPS. This is known as a one-out-of-two taken twice logic. The following examples illustrate the operation of the reactor trip circuit breakers.

a. If the A or C circuit breaker opens input power to one train of the SRPS's is lost.

b. If in addition, the B or D circuit breaker opens input power to the other train of the SRPS's is lost, which will result in the dropping of all rods (except APSR's) into the core.

The logic developed within the RPS Reactor Trip Modules will result in all AC breakers tripping if any two RPS channels receive a trip signal.

In summary, two tripped RPS channels will cause a reactor trip. For example, a reactor trip occurs if RPS channel B senses a low Reactor Coolant System (RCS) pressure condition and if RPS channel C senses a variable low RCS pressure condition. When the channel B bistable relay de-energizes, the channel trip relay de-energizes and opens its associated contacts. The same thing occurs in channel C, except the variable lower pressure bistable relay de-energizes the channel C trip relay. When the output logic relays in channel B and C de-energize, the B and C

BASES

BACKGROUND (continued)	contacts in the trip logic of each channel's reactor trip module (RTM) open causing an undervoltage to each trip breaker. All trip breakers and required ETA relay contactors open, and power is removed from all CRD mechanisms. All rods fall into the core, resulting in a reactor trip.
APPLICABLE SAFETY ANALYSES	Accident analyses rely on a reactor trip for protection of reactor core integrity, reactor coolant pressure boundary integrity, and reactor building OPERABILITY. A reactor trip must occur when needed to prevent accident consequences from exceeding those calculated in the accident analyses. The CONTROL ROD position limits ensure that adequate rod worth is available upon reactor trip to shut down the reactor to the required SDM. Further, OPERABILITY of the CRD trip devices ensures that all CONTROL RODS will trip when required. More detailed descriptions of the applicable accident analyses are found in the Bases for each of the individual RPS trip Functions in LCO 3.3.1, "Reactor Protective System (RPS) Instrumentation." The CRD trip devices satisfy Criterion 3 of CFR 50.36 (Ref. 2).
LCO	The LCO requires all of the specified CRD trip devices to be OPERABLE. Failure of any required CRD trip device renders a portion of the RPS inoperable and reduces the reliability of the affected Functions. Without reliable CRD reactor trip circuit breakers and associated support circuitry, a reactor trip may not reliably occur when initiated either automatically or manually. All required CRD trip devices shall be OPERABLE to ensure that the reactor remains capable of being tripped any time it is critical. OPERABILITY is defined as the CRD trip device being able to receive a reactor trip signal and to respond to this trip signal by interrupting power to the CRDs. Both of the CRD trip breaker's diverse trip devices and the breaker itself must be functioning properly for the breaker to be OPERABLE. For Unit(s) with the CRD/RTB upgrade not complete, both ETA relays associated with each of the three regulating rod groups and the two ETA relays associated with the auxiliary power supply must be OPERABLE to satisfy the LCO. The ETA relays associated with the APSR power supply

BASES

LCO (continued)

are not required to be OPERABLE because the APSRs are not designed to fall into the core upon initiation of a reactor trip.

Requiring all breakers and ETA relays (for Unit(s) with the CRD/RTB upgrade not complete) to be OPERABLE ensures that at least one device in each of the two power paths to the CRDs will remain OPERABLE even with a single failure.

APPLICABILITY

The CRD trip devices shall be OPERABLE in MODES 1 and 2, and in MODES 3, 4, and 5 when any CRD trip breaker is in the closed position and the CRD System is capable of rod withdrawal.

The CRD trip devices are designed to ensure that a reactor trip would occur if needed. Since this condition can exist in all of these MODES, the CRD trip devices shall be OPERABLE.

ACTIONS

A Note has been added to the ACTIONS indicating separate Condition entry is allowed for each CRD trip device.

A.1 and A.2

Condition A represents reduced redundancy in the CRD trip Function. For Unit(s) with the CRD/RTB upgrade complete, Condition A applies when:

- one diverse trip Function (undervoltage or shunt trip device) is inoperable in one or more CRD trip breaker(s).

For Unit(s) with the CRD/RTB upgrade not complete, Condition A applies when:

- One diverse trip Function (undervoltage or shunt trip device) is inoperable in one or more CRD trip breaker(s) or breaker pair; or
- One diverse trip Function is inoperable in both DC trip breakers associated with one protective channel. In this case, the inoperable trip Function does not need to be the same for both breakers.

If one of the diverse trip Functions on a CRD trip breaker (or breaker pair for Unit(s) with the CRD/RTB upgrade not complete) becomes inoperable, actions must be taken to preclude the inoperable CRD trip device from preventing a reactor trip when needed. This is done by manually tripping

BASES

ACTIONS

A.1 and A.2 (continued)

the inoperable CRD trip breaker or by removing power from the inoperable CRD trip breaker. Either of these actions places the affected CRDs in a one-out-of-two trip configuration, which precludes a single failure from preventing a reactor trip. The 48 hour Completion Time has been shown to be acceptable through operating experience.

B.1 and B.2

Condition B represents a loss of redundancy for the CRD trip Function. Condition B applies when both diverse trip Functions are inoperable in one or more trip breaker(s) (or breaker pair for Unit(s) with the CRD/RTB upgrade not complete).

Required Action B.1 and Required Action B.2 are the same as Required Action A.1 and Required Action A.2, but the Completion Time is shortened. The 1 hour Completion Time allowed to trip or remove power from the CRD trip breaker allows the operator to take all the appropriate actions for the inoperable breaker and still ensures that the risk involved is acceptable.

C.1 and C.2

Condition C does not apply to Unit(s) with the CRD/RTB upgrade complete. Condition C represents a loss of redundancy for the CRD trip Function. Condition C applies when one or more ETA relays are inoperable. The preferred action is to restore the ETA relay to OPERABLE status. If this cannot be done, the operator can perform one of two actions to eliminate reliance on the failed ETA relay. This first option is to switch the affected CONTROL ROD group to an alternate power supply. This removes the failed ETA relay from the trip sequence, and the unit can operate indefinitely. The second option is to trip the corresponding AC CRD trip breaker. This results in the safety function being performed, thereby eliminating the failed ETA relay from the trip sequence. The 1 hour Completion Time is sufficient to perform the Required Action.

D.1, D.2.1, and D.2.2

With the Required Action and associated Completion Time of Condition A, B, or C not met in MODE 1, 2, or 3, the unit must be brought to a MODE in which the LCO does not apply. To achieve this status, the unit must be brought to MODE 3, with all CRD trip breakers open or with power from all CRD trip breakers removed within 12 hours. The allowed Completion Time

BASES (continued)

ACTIONS

D.1, D.2.1, and D.2.2 (continued)

of 12 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging unit systems.

E.1 and E.2

With the Required Action and associated Completion Time of Condition A, B, or C not met in MODE 4 or 5, the unit must be brought to a MODE in which the LCO does not apply. To achieve this status, all CRD trip breakers must be opened or power from all CRD trip breakers removed within 6 hours. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to open all CRD trip breakers or remove power from all CRD trip breakers without challenging unit systems.

SURVEILLANCE REQUIREMENTS

SR 3.3.4.1

SR 3.3.4.1 is to perform a CHANNEL FUNCTIONAL TEST every 31 days. This test verifies the OPERABILITY of the trip devices by actuation of the end devices. Also, this test independently verifies the undervoltage and shunt trip mechanisms of the trip breakers. The Frequency of 31 days is based on operating experience, which has demonstrated that failure of more than one channel of a given function in any 31 day interval is a rare event.

REFERENCES

1. UFSAR, Chapter 7.
2. 10 CFR 50.36.